California ISO
Shaping a Renewed Future

CPUC Storage Proceeding

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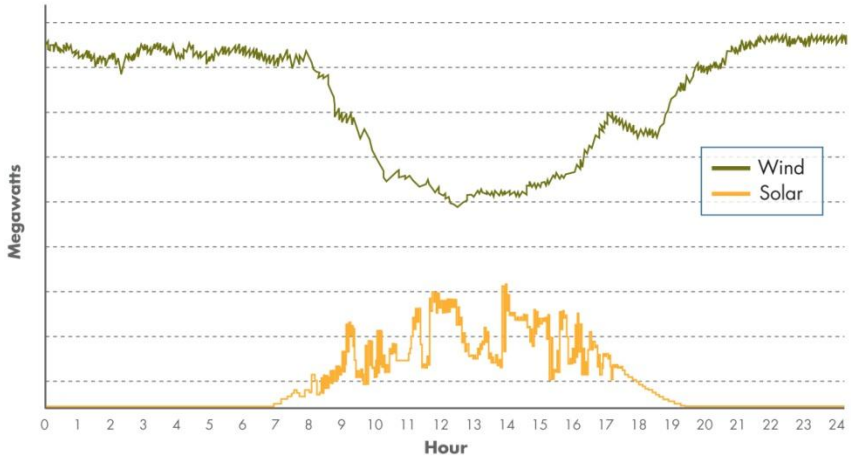
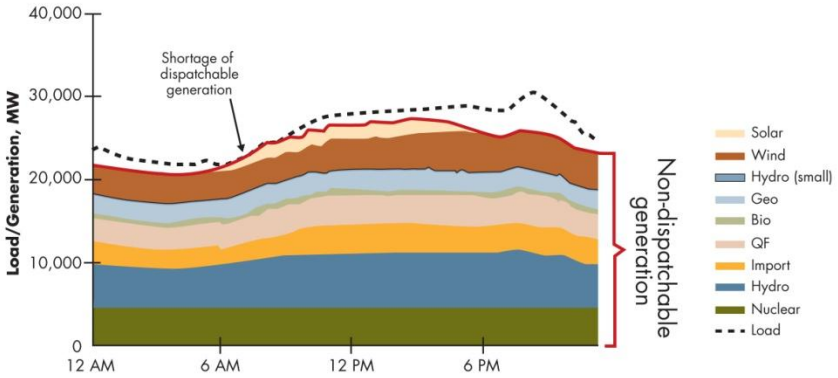
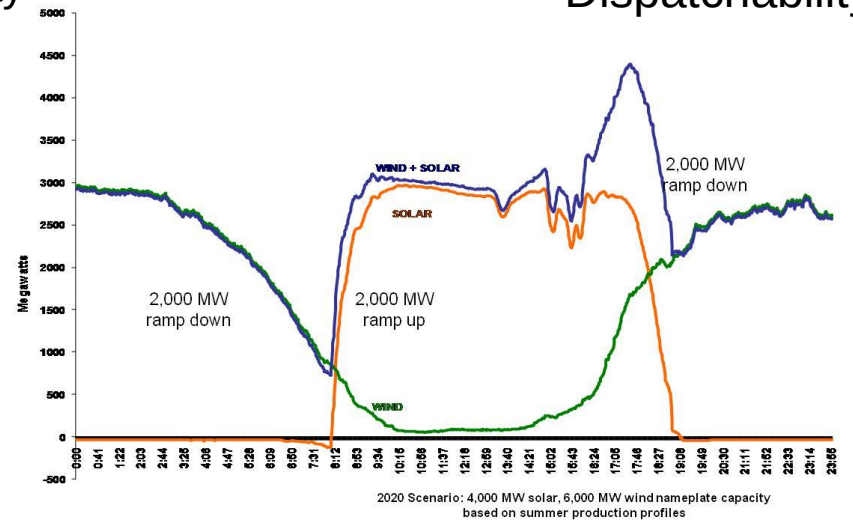
The ISO faces several challenges in maintaining reliability cost effectively.



Variability and uncertainty



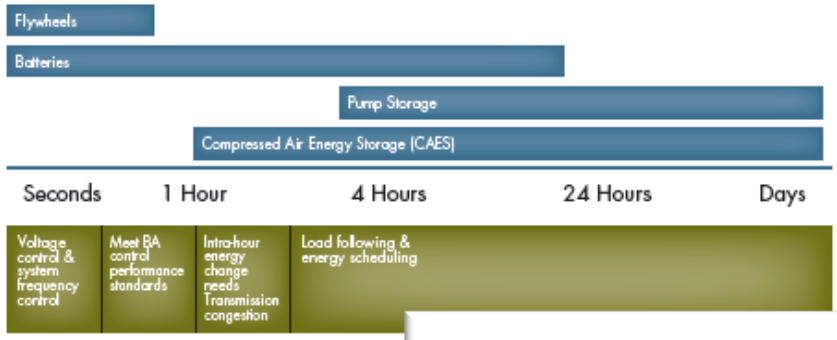
Dispatchability and Overgeneration



Increased ramping needs

Storage technology provides a flexible resource for maintaining reliability

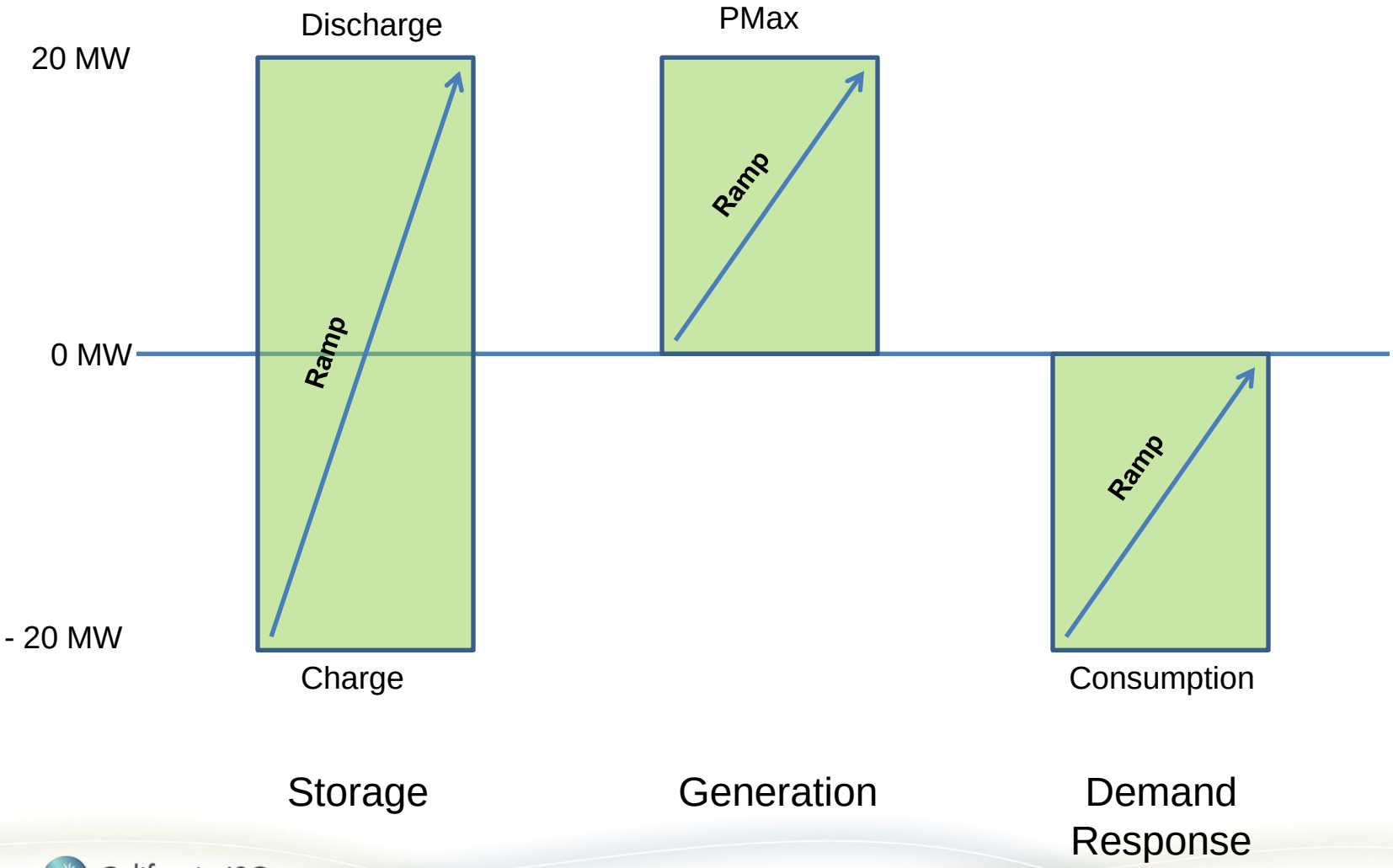
- Energy storage technology examples
  - Flywheel
  - Lithium Ion battery
  - Sodium Sulfur battery
  - Flow batteries
  - Compressed air energy storage
  - Pumped hydro
  - Electric Vehicles



Storage Vision:

Facilitate cost-effective, comparable participation in ISO markets to fully utilize technology capabilities.

Storage devices both withdraw and inject electricity from/to the grid



Ancillary services modifications to support non-generation resources – March 2010

- Removed resource type restrictions and reduced minimum rated capacity to 500 kW from 1 MW
- Reduced minimum continuous energy requirement from 2 hours to:
  - Day-Ahead Regulation Up/Down: 60 minutes
  - Real-Time Regulation Up/Down: 30 minutes
  - Spin and Non-Spin: 30 minutes
- Minimum continuous energy measured from the period that the resource reaches the awarded energy output
  - Measurement starts once resource reaches awarded energy, not end of 10 minute ramp requirement

Approved by FERC September 2010

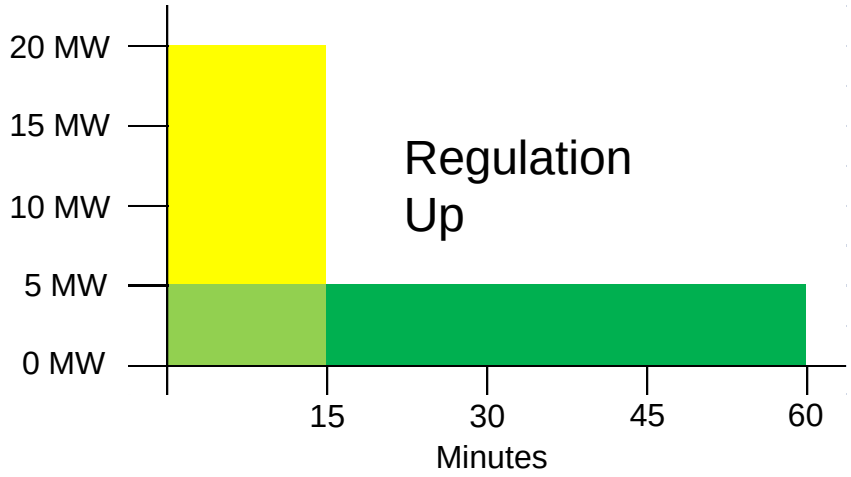
Regulation energy management provides additional functionality to address limitations of storage resources.

- Limited energy resources unable to participate in day-ahead regulation market at full capacity w/o REM
- Barriers to entry still existed even with March 2010 ancillary services modifications to support non-generation resources

Example: 20 MW / 5 MWh limited energy resource

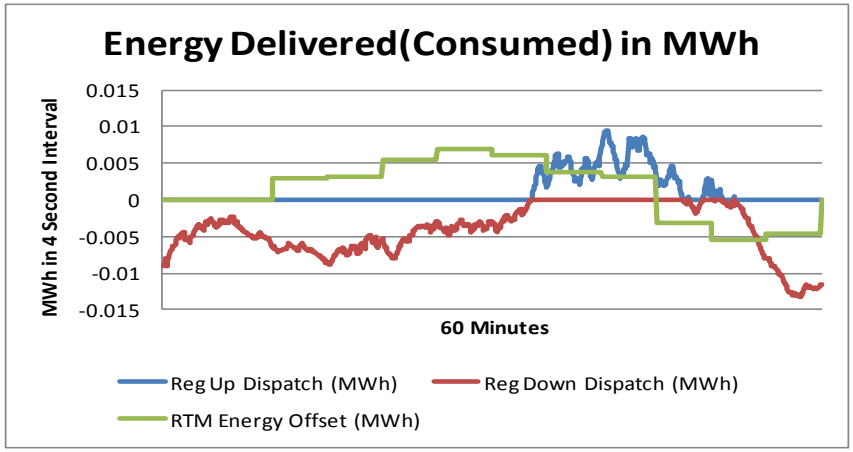
Green – prior requirement

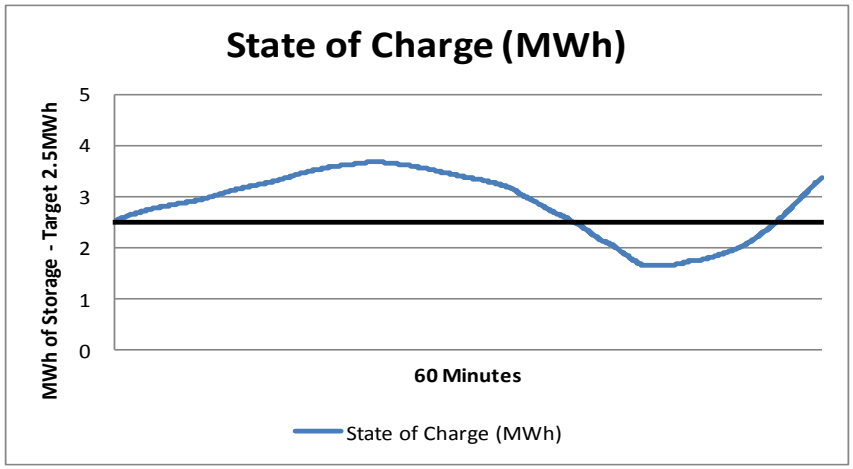
Yellow – regulation energy management



Approved by ISO Board February 2010. Implementation Spring 2012

REM maintains resource's state of charge to meet continuous energy requirement





- Utilize real time energy market for energy offset
- Regulation and energy settlement similar to conventional generation
- Regulation dispatch and energy offset keep state of charge near midpoint

Sources for additional ISO information

- 20% Renewables Integration Study – August 2010
  - http://www.caiso.com/2804/2804d036401f0.pdf
- Renewables Integration Initiatives
  - http://www.caiso.com/1c51/1c51c7946a480.html
- Renewables Integration Market and Product Review
  - http://www.caiso.com/2b3d/2b3d8b92f940.html
- Regulation Energy Management
  - http://www.caiso.com/2b05/2b05e7075f6d0.pdf

FERC proceedings related to storage

- *Third Party Provision of Ancillary Services; Accounting and Financial Reporting for new Electric Storage Facilities*, FERC Docket Nos. RM11-24-000 and AD10-13-000 (June 16, 2011)

- *Frequency Regulation Compensation in the Organized Wholesale Power Markets*, FERC Docket Nos. RM11-7-000 and AD10-11-000 (February 17, 2011)